Swami Ramanand Teerth Marathwada University, Nanded

SUBMISSION OF THE Ph.D. REGISTRATION SYNOPSIS ON THE TOPIC

"Human Identification Based on Ear Biometric Features"

UNDER THE

FACULTY OF SCIENCE AND TECHNOLOGY

IN THE SUBJECT OF

COMPUTER SCIENCE

SUBMITTED BY

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UNDER THE GUIDANCE OF

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1. Abstract

Person identification from ear images is an active field of research within the biometric community. Similar to other biometrics such as face, iris and fingerprints, ear also has a large amount of specific and unique features that allow for person identification. In this current worldwide outbreak of COVID-19 situation, most of the face identification systems fail due to the mask wearing scenario. The human ear is a perfect source of data for passive person identification as it does not involve the cooperativeness of the human whom we are trying to recognize and the structure of ear does not change drastically over time. It has been proved that ear of every individual is unique and can be used as a biometric to overcome the limitations of the biometrics used today. Acquisition of a human ear is also easy as the ear is visible even in the mask wearing scenarios. The system has two steps. In the first step, the ear is detected from the profile image of the face. In the second step, the ear image is transformed to a force field, then feature points are extracted and the best match is found from a database.

Keywords: Edge detection, Feature extraction, Classifier, Ear Recognition

2. Introduction

Biometrics deals with identification of individuals based on their characteristics. In traditional systems people use to remember passwords, PIN's, tokens for identification. But in recent year’s biometrics have gained a lot of popularity due to advancement in technology and the secure environment.Traditionally, biometric systems that use only one biometric trait biometric system are very common. Many drawbacks to these systems were reported. Some biometric systems in the literature were reviewed and successfully developed to significantly overcome some of these problems. The automatic recognition of individuals based on biological and behavioral traits is one meaning, apparently dating from the early 1980s. However, in biology, agriculture, medicine, public health, demography, actuarial science, and fields related to these, biometrics, biometry, and biostatistics refer almost synonymously to statistical and mathematical methods for analyzing data in the biological sciences.

These systems were proposed to fulfill the need for better recognition accuracy by consolidating more than one independent source of evidence to recognize individuals and

ensuring identities. Moreover, some overcome spoofing to some extent by adding complexity to the personality characteristics. Face profile and ear multimodal biometrics systems have not given much attention in the literature and especially the profile side views that can be acquired by surveillance cameras in no controlled environment or even in a controlled environment. Very limited research articles in this area are found in the literature. At the time of writing this synopsis, there were only 2 publications that we are aware of.

Ear recognition has gained tremendous attention over the last three decades, since it is considered a simplified image analysis and pattern recognition application. There are at least two reasons for understanding this trend: (1) the large variety of commercial and legal requests, besides (2) the availability of the relevant technologies (e.g., smartphones, digital cameras, GPU,). Although the existing machine learning/recognition systems have achieved some degree of maturity, their performance is limited to the conditions imposed in real-world applications.

2.1 Biometric Systems

Biometric systems address the issue of non-universality. For example, if a person's poor quality of fingerprints prevents him from enrolling in the system; then the use of other biometric traits such as iris, face, voice etc. will help the system acquire meaningful biometric data and enroll the user. It is extremely difficult to spoof multiple biometric traits of a ones legitimate user. If each subsystem determines the probability of the particular trait being a spoof, it is possible to find out the probability of the user being an imposter by using an appropriate fusion technology.A challenge response mechanism can be included that asks user to present the random subset of traits at the point of acquisition. This would ensure that the system is interacting with a live user. Multi biometric systems effectively address the problem arising because of noisy data. When the information acquired from one biometric trait is corrupted by noise, it is possible to use information acquired from the other biometric trait. Some systems also take into considerations the quality of acquired input biometric signals during the fusion process. Estimating the quality of acquired biometric data is in itself a challenging

In this research, we present a system of the multimodal biometrics using the face and ear. All the approaches are classified according to their fusion methodologies. For this aim, we also

give an illustration about the biometric fusion methodologies. In the end, we pay particular attention to an adaptive face- and ear-based multimodal identification system presented in research.

3. Ear Biometrics

Figure 1 represents the overall construction of the ear biometric system. Initially, a database of side face images is composed using a camera. During the data collection, there are chances that certain kinds of noise may be introduced in the images, so they are first pre-processed. The next stage is to detect the location of the ear in the image. This step is crucial and needs to be error-free as it disturbs the system's overall presentation. The cropped ear suffers from various challenges like position and scale. Hence, ear normalisation is performed to eliminate these issues, and they are aligned along the vertical line. In the next step, a robust method is required to extract the ear biometrics' unique feature. These features can be obtained using handcrafted or deep learning methods. These unique features with their identities are stored in the database, which is called the enrolment stage. During matching, a query image and identity pass through the system, and a matching score is calculated between the stored features and features of the query image based on Euclidean distance. The matching

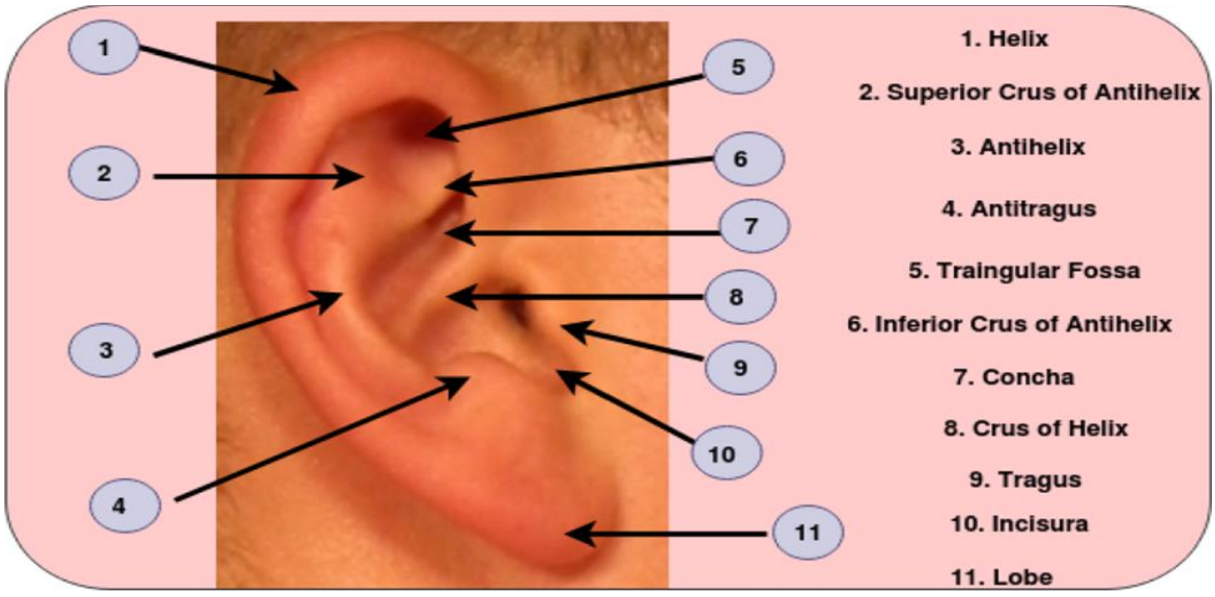

Figure:-1 Anatomy of Ear

2. Review of Literature and Development in the subject:

Shruti Nikose, Hemant Kumar Meena et.al. In this paper Ear-biometrics for human identification author used the basic deep learning concept of convolutional neural network model they also used Gaussian filter and canny edge detector is applied and Keras sequential CNN model to the dataset [1]. Ramar Ahila Priyadharshini & Selvaraj Arivazhagan & Madakannu Arun Ms. Gayatri U. Bokade, Dr. Rajendra.D. Kanphade developed multimodal biometric authentication using three biometric traits viz, Face, palmprint and ear. Hisresearch of authenticating a person on the basis of three physical traits enhances accuracy of authentication. Principal component Analysis is used for dimension reduction and feature extraction. He used one algorithm of Principal Component Analysis for feature extraction and Euclidean distance for final matching make the system robust by reducing the computational complexity [2]. Insaf Adjabi, Abdeldjalil Ouahabi, Amir Benzaoui and Abdel malik Taleb-Ahmed have reviews on some past, present and futures of face recognition systems. He provides systematic review the new state-of-the-art in facial recognition research in a comprehensive [3]. The main lessons learnt from this study are that 2D facial recognition is still open to future technical and material developments for the acquisition of images to be analyzed. On the other hand, the attention of researchers is increasingly attracted by 3D facial recognition. The recent development of 3D sensors reveals a new direction for facial recognition that could overcome the main limitations of 2D technologies, e.g., changes in physical appearance, aging factor, pose, changes in light intensity, and more generally by facial expressions, missing data, cosmetics, and occlusions.

The geometric information provided by data could significantly improve the accuracy of facial recognition in the presence of adverse acquisition conditions. However, the lack of a 3D facial recognition database hinders the exploitation of methods based on deep learning. Also, interpretation of the 3D facial expression, identification under variations in age, and transfer learning are three open challenges that are still in their beginning and requires further researches. Multimodality (voice, iris, fingerprint,), soft facial biometrics, infrared imaging, sketches, and deep learning without neglecting conventional machine learning methods are tracks to be considered in the near future.[2].

Various types of information can be combined. In this paper we have discussed the various levels of fusion that are used in fusing information in multi biometric systems. Sensor level fusion combines the information at raw level and is not very complicated. Although raw data is the rich in information, it is there is high probability that raw data is contaminated by noise. Feature level fusion involves fusion of the feature sets originating from multiple information sources (from multiple feature extractors). Compared to the raw data, noise is suppressed in feature-level representation. Moreover, feature transformation algorithms can be applied to the augmented feature sets which enable the detection/removal of correlated feature values improving recognition accuracy [3].

Vitomir Struc, Peter Peer Ziga Emeršič et. Al three methods (Borda, Bayesian, and weighted Bayesian combination) of combining results of the different approaches but do not find improved performance over the best individual method. Choras [6], [7] introduces an ear recognition method based on geometric feature extraction from 2D images of the ear. The geometric features are computed from the edge detected intensity image. They claim that error-free recognition is obtained on “easy” images from their database. The “easy” images are images of high quality with no earring and hair covering and without illumination changes. No detailed experimental setup is reported. Bhanu and Chen [8] presented a 3D ear recognition method using a local surface shape descriptor. Twenty range images from 10 individuals are used in the experiments and a 100 percent recognition rate is reported. In [9], Chen and Bhanu used a two-step ICP algorithm on a data set of 30 subjects with 3D ear images. They reported that this method yielded two incorrect matches out of 30 people. In these two works, the ears are manually extracted from profile images. They also presented an ear detection method in [10]. In the offline step, they built an ear model template from each of 20 subjects using the average histogram of the shape index [11]. In the online step, first, they used step edge detection and thresholding to find the sharp edge around the ear boundary and then applied dilation on the edge image and connected component labeling to search for ear region candidates. Each potential ear region is a rectangular box, and it grows in four directions to find the minimum distance to the model template. The region with minimum distance to the model template is the ear region. They get 91.5 percent correct detection with a 2.5 percent false alarm rate. No recognition results are reported based on this detection method. Hurley et al. [12] developed a novel feature extraction technique

using force field transformation. Each image is represented by a compact characteristic vector which is invariant to initialization, scale, rotation, and noise. The experiment displays the robustness of the technique to extract the 2D ear. Their extended research applies the force field technique to ear biometrics [13]. In the experiments, they used 252 images from 63 subjects with four images per person collected during four sessions over a five month period; any subject is excluded if the ear is covered by hair. A classification rate of 99.2 percent is claimed on this 63-person data set. The data set comes from the XM2VTS face image database [14]. Yan and Bowyer [15] presented a complete system for ear biometrics, including automated segmentation of the ear in a profile view image and 3D shape matching for recognition. We evaluated this system with the largest experimental study to date in ear biometrics, achieving a rank-one recognition rate of 97.8 percent for an identification scenario and an equal error rate of 1.2 percent for a verification scenario on a database of 415 subjects and 1,386 total probes. Bay et al. [16] present a fast scale and rotation-invariant interest point detector and descriptor, namely SURF. In their research, they implement a kind of approximation of Hessian-matrix to detect interest points, and utilize a series of box filters which are approximate second order Gaussian derivatives to build scale spaces. Chandrasekhar et al. [17] propose a sort of new framework for computing low bit-rate feature descriptors. They test a various coding methods and distance measures, and compare their CHoG descriptor with other low-bit-rate descriptors. Their experiment results show that CHoG outperforms other descriptor schemes at the same bit rate. The rest of the paper is organized as follows: In section 3, we describe the details of our ear recognition algorithm. Section 4 presents the experimental methods and the experimental results. Section 5 provides the conclusions.

4. Objectives of Research:

- The human ear images and its features like helix, rim, lobe using these features we will try to implement system of high enrolment, accuracy and verification rates.
- Automatic human identity recognition from ear images represents an active field of research within the biometric community.
- To represent a new approach for human identification using ear biometrics features.

4. Methodology to be adopted:

Here we are working on the Ear Images which is stored in database and database will created by standard database. We will try to develop this system using machine learning approach. Following is the methodology how implementation will be.

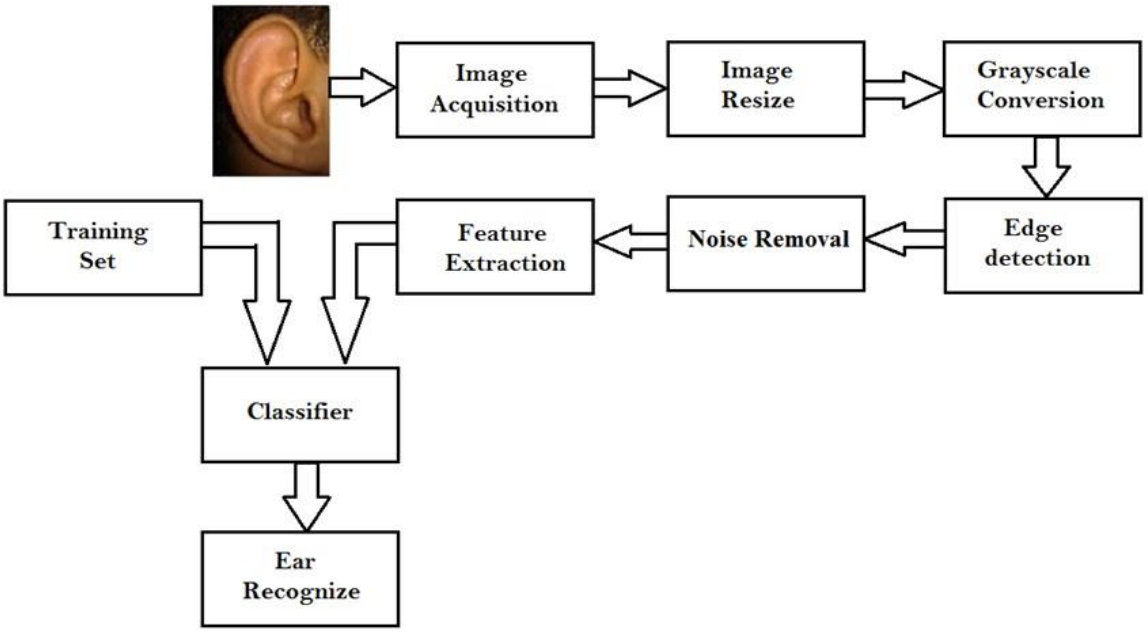

Figure:-2 Proposed Ear Biometrics Methodology

The matching algorithms generate a score for each template comparison based on the distance between the tested and stored feature vectors. The Euclidean distance metric will use, for good results at a low computation cost. The lowest distance score value indicates the best match.

5. Importance of study/ Society application:

- The future of Ear recognition is not well defined as it seems that there are future innovations that can complement current biometric capacities. But, one thing is for sure, with the speed of technology innovation and increased frequency and use of features for the purposes of convenience, security, and data collection, it can be expected that there is a solid future for facial recognition
- From this point, it is safe to assume that there will be improvements and new uses for the software coming soon, such as more privacy for the consumer or less expensive versions of the software. The specific details and possibilities depend on society's feedback to the current models in use today, but nonetheless, the collective benefits such as ease of access and versatility firmly suggests that facial recognition technology may be worth the future efforts.

- The smallest bones in the human body of ear. That would be quite difficult for cybercriminals to duplicate. In addition, it can be used to measure temperature, blood flow, heart rate, and glucose levels.
- Ear biometric system will have diverse uses in the fields — authentication, access and attendance control, travel control, financial and other transactions requiring authorizations, remote voting, use of automated working devices, action control. e.g., nowadays airports use a combination of face & iris biometrics to authenticate a person, instead, a single ear biometric system can be used to achieve the authenticity of a person with the same accuracy.

- Every single feature of the face and ear has an impact on how a person's general personality is going to be like — face, eyes, palms & even handwriting.
- Ear lobe has many features that can be used for Personality analysis — attached lobe, broad lobe, narrow ear, pointed ear, round lobe, square ear, ear sticking out, etc.

International scope:

- International scope: Not only Indian peoples but also each and every person who leaving in earth and he/she has a biometrics modalities.
- We are trying to implement this system on Local database verities and developed and created a huge amount of database in our research.

Limitations

- There would be cases of occlusions of different types like hair, earphones, or ear is injured or covered with cloth. The chances of an individual getting authenticated would become less.
- As the percent of pure ear and face taken for feature extraction is less so the accuracy would be affected. The system aims to concern small environment rooms like security rooms, board meetings, medical labs, etc.

5. Proposed work Plan/ Formulation and Structure of Study:

First Year	Ist Half	Literature study
	IInd Half	Experimental Work
Second Year	Ist Half	Experimental Work
	IInd Half	Comparative study
Third Year	Ist Half	Result Interpretation
	IInd Half	Conclude the Work

Tentative Chapter Scheme

- Chapter 1: Introduction
- Chapter 2: Literature review
- Chapter 3: Objective of Research
- Chapter 4: Implementation of Techniques for Proposed Work.
- Chapter 5: Conclusion and Future work

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